PROCEEDINGS OF THE BIOLOGICAL SOCIETY OF WASHINGTON
115(4):727–736. 2002.

Aspidoras velites, a new catfish from the upper Rio Araguaia basin, Brazil (Teleostei: Siluriformes: Callichthyidae)

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Abstract.—Aspidoras velites, from the upper Rio Araguaia basin (Rio Tocantins drainage) in Central Brazil, is described. The new taxon is an unusual corydoradine species, showing several reductive features, and resembling in external morphology and coloration the loricariid hypoptopomatine catfishes. The new species differs from its congeners by a naked predorsal area, the first pectoral-fin element not modified as a spine, a weak dorsal spine, minute vermiculate platelets on the ventral surface between the isthmus and pelvic regions, a short narrow posterior process of supraoccipital, and the presence of three longitudinal dark stripes. Some of the features presented above are reductive, possibly indicating that the new species is paedomorphic.

Resumo.—Aspidoras velites, da bacia do alto Rio Araguaia (drenagem do Rio Tocantins) no Brasil, é descrita. O novo táxon é uma espécie de coridoradíneo bastante incomum, com vários caracteres redutivos, e assemelha-se na morfologia externa e coloração aos loricariídeos hipoptopomatíneos. A nova espécie difere de suas congêneres pela área pré-dorsal nua, o primeiro elemento da nadadeira peitoral não modificado em um espinho, o espinho da nadadeira dorsal delgado, minúsculas placas vermiculadas na superfície ventral, entre o istmo e a região pélvica, o processo posterior do supraoccipital curto e estreito e presença de três faixas longitudinais escuras. Algumas das características apresentadas acima são redutivas, o que possivelmente indica uma condição pedomórfica para a nova espécie.

The genus *Aspidoras* comprises 18 nominal species of catfishes occurring in several river drainages of central, northeastern, and northern Brazil (Britto 2000). Notwithstanding several contributions to the taxonomy of the genus (Nijssen & Isbrücker 1976, 1980; Weitzman & Balph 1979; Britto 1998, 2000; Lima & Britto 2001), the status of most species as well as their phylogenetic relationships are still poorly known.

During a recent fish survey in the upper Rio Araguaia system in Estado do Mato Grosso, Brazil, two of the authors (FCTL and CRM) collected an unusual corydoradine catfish, which superficially resembled a hypoptopomatine loricariid. Examination of the preserved material revealed that this striking catfish was a new species of *Aspidoras* with several putatively paedomorphic features. The upper Rio Araguaia is bounded in the southeast by tributaries of the Rio Paranaíba, Rio Paraná basin, and in the southwest, by headwaters of the Rio Itiquira and the Rio Taquari, Rio Paraguai basin. The upper Rio Itiquira, type locality of the recently described *Aspidoras taurus* Lima & Britto (2001), is situated only about 40 km from the type locality of the new species. The present find reinforces the view that the upper portions of the main river systems of Central Brazil harbor a diverse and endemic assemblage of fishes.

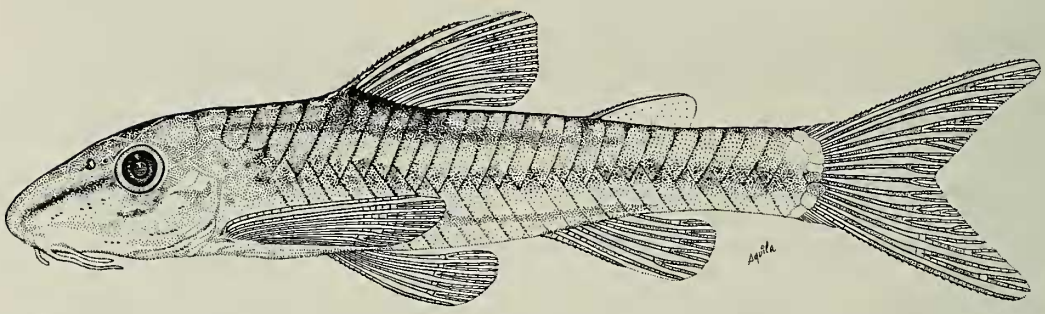

Fig. 1. *Aspidoras velites,* new species, holotype, MZUSP 77447, 23.6 mm SL; Brazil, Mato Grosso, Alto Araguaia, córrego Boiadeiro.

Material and Methods

Morphometric and meristic data were taken according to Reis (1997) for the subfamily Callichthyinae, except for the length of the anal spine, which is absent in all corydoradines, and pectoral-spine length, absent in the new species. Measurements were obtained using 0.1 mm precision calipers. Tooth and vertebral counts were taken from cleared and stained (cs) material, prepared according to Taylor & Van Dyke (1985). Vertebral counts included only free centra; the compound caudal centrum (preural 1 + ural 1) was counted as a single element. In the description, the frequency of each count is provided in parentheses after the respective count. Counts from the holotype are indicated by an asterisk. Drawings were made with the aid of a camera lucida of the left side of the specimens; stippling indicates bone, and small circles indicate cartilage. Osteological terminology follows Reis (1998). Nomenclature of latero-sensory canals follows Schaefer & Aquino (2000). Homology of preopercular pores follows Schaefer (1988). Institutional abbreviations are as listed by Leviton et al. (1985).

Aspidoras velites, new species
Figs. 1–3

Holotype.—MZUSP 74447, female, 23.6 mm SL; Brazil, Estado do Mato Grosso, município de Alto Araguaia, córrego Boiadeiro, km 487.08 of Ferronorte railroad, 17°20′01″S, 53°14′53″W; C.R. Moreira & F.C.T. Lima, 16 May 2001.

Paratypes.—All localities in Brazil, Estado do Mato Grosso, município de Alto Araguaia: AMNH 232394, 5 ex., 14.7–20.5 mm SL; INPA 18147, 5 ex., 18.0–21.4 mm SL; MCP 29060, 5 ex., 17.3–22.3 mm SL; MZUSP 73264, 89 ex., 8 cs, 9.6–24.7 mm SL; USNM 367502, 5 ex., 15.5–19.9 mm SL; same data as holotype. MZUSP 73247, 25 ex., 15.8–27.9 mm SL; córrego Gordura,

Fig. 2. *Aspidoras velites,* new species, lateral view of paratype, MZUSP 73264, 24.7 mm SL; Brazil, Mato Grosso, Alto Araguaia, córrego Boiadeiro.

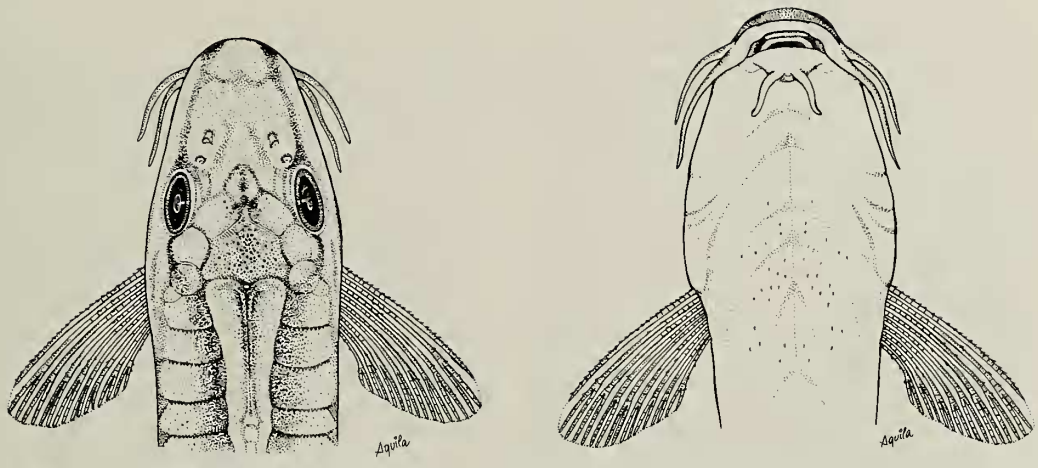

Fig. 3. Dorsal (left) and ventral (right) views of head and pectoral fins of *Aspidoras velites,* new species, holotype, MZUSP 77447, 23.6 mm SL; Brazil, Mato Grosso, Alto Araguaia, córrego Boiadeiro.

km 491.4 of the Ferronorte railroad, 17°18′20″S, 53°16′22″W; C.R. Moreira & F.C.T. Lima, 15 May 2001. MZUSP 73351, 19 ex., 13.8–26.6 mm SL; ribeirão do Sapo, Km 464.04 of Ferronorte railroad, 17°31′11″S, 53°15′33″W; C.R. Moreira & F.C.T. Lima, 21 May 2001.

Diagnosis.—*Aspidoras velites* is distinguished from its congeners by the following unique features: naked predorsal area (vs. covered with dorsolateral body plates); first pectoral-fin element not modified as spine (vs. modified as spine); minute vermiculate platelets present on ventral surface between isthmus and pelvic regions (vs. platelets absent); posterior process of supraoccipital narrow (vs. wide), and separated from nuchal plate by distance of twice its length (vs. about one-fourth); dorsal-fin spine weak (vs. strong).

Aspidoras velites also is distinguished from all other *Aspidoras* species, except *A. virgulatus,* by the presence of three longitudinal dark stripes. In addition to the characters mentioned above, it is also distinguished from *Aspidoras virgulatus* by smaller body depth, 15.0–20.3% SL (vs. deeper body, 24.9–34.3% SL), and absence of odontodes on sides of head in mature males (vs. presence).

Description.—Morphometric data are given in Table 1. Head slightly compressed, dorsal profile straight to slightly convex. Snout bluntly pointed in dorsal view. Dorsal profile of body weakly convex from tip of supraoccipital process to base of last dorsal-fin ray. Profile slightly concave, nearly straight, from that point to adipose-fin spine. Profile straight from that point to caudal-fin base; slightly concave in small specimens. Ventral body profile slightly convex from isthmus to ventral region of cleithrum, concave at coracoids, convex at pelvic girdle region. Profile straight from that point to first anal-fin ray, slightly concave from latter point to caudal-fin base. Trunk roughly cylindrical in cross-section at pectoral girdle, gradually more compressed towards caudal fin.

Eye lateral; orbit delimited dorsally by frontal and sphenotic, ventrally by infraorbitals. Anterior and posterior nares close to each other, separated by thin flap of skin; anterior naris tubular. Posterior naris close to anterodorsal margin of orbit, separated from it by distance equal to naris diameter. Mouth subterminal, nearly as wide as bony orbit. Two pairs of maxillary barbels, and one pair of mental barbels. Ventral maxillary barbel slightly longer than dorsal, reaching anterior limit of gill opening ventrally. Minute rounded papillae present on

Table 1.—Morphometric data for the holotype and paratypes of *Aspidoras velites* (MZUSP 73247, n = 15; MZUSP 73351, n = 10; MZUSP 73264, n = 14).

Character	Holotype	n	Range	Mean
Standard length (mm)	23.6	40	20.1–27.9	—
Percentages of standard length				
Depth of body	20.3	40	15.0–20.3	17.9
Predorsal distance	37.7	40	37.7–43.6	40.6
Prepelvic distance	41.5	40	38.6–46.3	42.6
Preanal distance	63.1	40	60.8–73.5	65.4
Preadipose distance	75.8	40	70.0–77.6	73.9
Length of dorsal spine	8.9	39	4.7–9.0	6.6
Length of adipose-fin spine	10.2	38	6.8–12.5	9.6
Depth of caudal peduncle	11.0	40	9.3–11.3	10.2
Dorsal to adipose distance	22.5	40	16.7–25.7	21.2
Length of dorsal-fin base	14.0	40	9.6–17.0	14.1
Maximum cleithral width	14.8	40	12.5–17.1	15.0
Head length	28.8	40	26.9–32.3	29.2
Length of upper maxillary barbel	9.3	40	9.1–13.2	11.0
Percentages of head length				
Head depth	60.3	40	53.2–64.6	59.0
Least interorbital distance	33.8	40	30.3–38.3	34.1
Horizontal orbit diameter	22.1	40	12.7–22.1	18.1
Snout length	54.4	40	44.6–56.2	50.4
Least internareal distance	14.7	40	11.1–17.9	14.6

entire surface of barbels, upper and lower lips, and isthmus. Gill membranes united to isthmus. Four branchiostegal rays covered by thin skin; distalmost two rays united at tips by branchiostegal cartilage. Teeth on upper pharyngeal tooth plate 19; teeth on fifth ceratobranchial 15. Males with lanceolate genital papilla near anus. Females with small rod-like genital papilla. Minute vermiculate platelets present on ventral surface between isthmus and pelvic regions, each bearing one to three minute odontodes (Fig. 4).

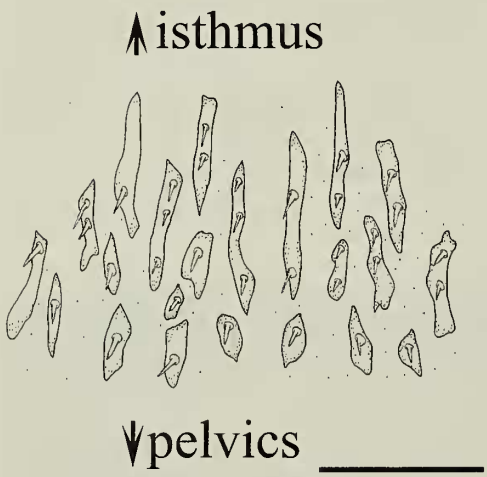

Fig. 4. Detail of vermiculate platelets on ventral surface between isthmus and pelvic regions of *Aspidoras velites*, new species, paratype, MZUSP 73264, 24.5 mm SL. Scale bar 1 mm.

Nasal, frontal, sphenotic, pterotic-supracleithrum, and supraoccipital bones visible externally; all, except nasal, bearing scattered minute odontodes. Two cranial fontanels present, both covered by thin skin. Anterior fontanel small, ovoid, delimited only by frontal bones; its posterior margin contacting anterior margin of supraoccipital. Posterior fontanel restricted to posterior region of supraoccipital bone, smaller than anterior fontanel. Nasal bone slender, slightly curved, inner margin contacting frontal. Frontal bone rectangular, anterior extension contacting nasal bone. Posteriorly, frontal contacting sphenotic and supraoccipital. Sphenotic trapezoid, contacting supraoccipital dorsally, pterotic-supracleith-

rum posteriorly and infraorbital 2 ventrally. Pterotic-supracleithrum pipe-shaped; anterior (deeper) portion contacting sphenotic anteriorly and supraoccipital dorsally, posterior (slender) portion contacting first dorsal body plate dorsally, and first lateral line ossicle posteriorly. Pterotic-supracleithrum contacting opercle and cleithrum ventrally. Supraoccipital quadrangular, with small, extremely narrow posterior process separated from nuchal plate by distance equal to twice its length. Two infraorbital bones, both visible externally, with minute odontodes scattered on surface.

Opercle and preopercle visible externally. Opercle deep, free margin straight. Posterior region of interopercle visible externally. Opercle, interopercle, and preopercle with minute odontodes scattered on surface.

Trunk lateral line usually restricted to three latero-sensory canals; posteriormost canal encased in fourth dorsolateral plate, anterior canals restricted to small ossicles. One small specimen (MZUSP 73264, 17.5 mm SL) with six canals. Lateral-line canal entering neurocranium through pterotic-supracleithrum, splitting into two branches before entering sphenotic: pterotic and preoperculomandibular, each with single pore. Sensory canal continuing through pterotic-supracleithrum, entering sphenotic as temporal canal, which splits into two branches. One branch giving rise to infraorbital canal, and other branch entering frontal through supraorbital canal. Supraorbital canal with two branches: epiphyseal, opening near anterior fontanel; and anterior, running through nasal bone. Nasal canal with two openings: posterior, where supraorbital canal enters nasal; and anterior opening on tip of bone. Infraorbital canal running through entire second infraorbital, entering infraorbital 1, opening in two pores. Preoperculomandibular branch giving rise to preoperculomandibular canal, which runs through entire preopercle with three openings, corresponding to pores 3, 4, and 5, respectively.

Two series of vertically elongate lateral plates covering body. Anterior dorsolateral plates not reaching dorsal midline, leaving naked predorsal area. Nuchal plate small, visible externally. One to five unpaired minute mid-dorsal platelets anterior to adipose fin. Seven to nine small lateral plates along caudal-fin base. All plates with minute odontodes restricted to their posterior borders. Coracoids covered by skin ventrally. Cleithrum visible externally, with minute odontodes scattered on surface. Dorsolateral body plates 25 (2), 26 (15), or 27* (23); ventrolateral body plates 24* (21), 25 (18) or 26 (1); dorsolateral plates along dorsal-fin base 4 (10), 5* (29), or 6 (1); dorsolateral plates from adipose fin to caudal-fin base 8 (7), 9* (31), or 10 (2). Precaudal vertebrae 8; caudal vertebrae 17; total free vertebrae 25; five pairs of ribs, first rib conspicuously more developed than others.

Dorsal fin roughly triangular, originating just posterior to fourth dorsolateral body plate. Dorsal spine slender, shorter than first four dorsal-fin rays, posterior margin smooth. Dorsal-fin rays I,7 (17) or 8* (20). Adipose fin roughly triangular; its origin separated from base of last dorsal-fin ray by nine plates. Small curved adipose-fin spine, usually present (absent in one specimen). Anal fin roughly ellipsoid, origin just posterior to 14th ventrolateral body plate. Anal-fin rays ii,5* (33) or 6 (7). Pectoral fin roughly ovoid, originating just posterior to gill opening. First pectoral-fin element not differentiated into spine in most specimens; its segments not co-ossified. Some specimens with remnant co-ossification among proximal segments of first pectoral ray. Pectoral-fin rays i,7 (1), 8 (27), or 9* (12). Pelvic fin roughly ellipsoid, originating just below fourth ventral body plate, at vertical through base of second branched ray of dorsal fin. Pelvic-fin rays i,5. One specimen lacking pelvic fins. Caudal fin moderately forked, lobes bluntly pointed and equal in size. Principal caudal-fin rays i,6/6,i; two specimens with i,6/10,i and i,4/5,i, respectively. Upper and lower procur-

rent caudal-fin rays iv–v/v–vi. All fins with minute odontodes scattered on all rays.

Color in alcohol.—Ground color dull white to tan. Dark stripe on snout running from corner of maxillary barbels to eye. Scattered dark chromatophores on dorsal surface of snout, more concentrated along mesial margin of nares. Maxillary barbels tan. Dorsal surface of head with heavy concentration of dark chromatophores. Thin patch of dark chromatophores lying below ventral margin of eye. Dark chromatophores forming roughly comma-shaped patch on opercle. Dorsal dark stripe, more conspicuous anteriorly, running from posterior margin of eye, through upper portion of dorsolateral body plates to dorsal portion of caudal peduncle. Dorsal dark stripe confluent, at adipose-fin base, with dorsal stripe of opposite side; dark chromatophores more concentrated on origin and terminus of dorsal fin, and on origin of adipose fin, forming dark saddle marks. Dark chromatophores scattered on naked predorsal area. Ground color on dorsal surface of snout and body grayish- to reddish-brown. Ground color of lateral surface of head and body light. Wide, straight dark mid-lateral stripe extending from cleithrum to caudal-fin base platelets. Stripe faint from cleithrum to vertical through dorsal-fin origin, becoming wider on caudal peduncle. Most specimens with deep-lying, reddish-brown pigmentation along entire length of stripe. Narrow, straight dark stripe running from pelvic-fin origin to terminus of anal-fin base. Ventral surface of head and trunk dull white, almost devoid of dark chromatophores. Dorsal fin with dark chromatophores on proximal portions of rays. Diffuse reddish-brown pigmentation present on dorsal-fin rays in most specimens. Dark chromatophores on tip of adipose-fin spine. Reddish-brown pigmentation on adipose fin. Caudal fin with scattered dark chromatophores on rays. Patches of reddish-brown pigmentation on most of caudal fin. Roundish area devoid of pigment on base of upper caudal-fin lobe. Some specimens with dark chromatophores on proximal portions of anal-fin rays. Reddish-brown pigmentation mostly on median portion of anal-fin rays. Sparse, scattered dark chromatophores on pectoral- and pelvic-fin rays. Faint reddish-brown color on pectoral- and pelvic-fin rays; interradial membranes hyaline.

Color in life.—Based on transparencies from one specimen (MZUSP 73247, 27.9 mm SL). Ground color grayish. Reddish-brown pigmentation on dorsal surface of head and caudal-fin base. Stripes grayish-brown. Bright gold on sides of head and anterior portion of trunk. Two approximately symmetrical light roundish blotches present on upper and lower caudal-fin base.

Sexual dimorphism.—Genital papilla is sexually dimorphic in Corydoradinae (Nijssen & Isbrücker 1980:135; Britto 1997). As in the remaining members of Corydoradinae, males of *Aspidoras velites* possess a lanceolate genital papilla. Examination of all specimens of the new species revealed that the sex ratio is nearly 1:1.

Habitat and ecological notes.—The new species was collected in medium-sized streams, relatively shallow (0.5 to 1.2 m deep), with sandy banks, densely covered by aquatic macrophytes, alternating with deep pools (2.0–5.0 m deep), with sand or pebbles substrate. Water transparency was high, and current speed was moderate in all streams. *Aspidoras velites* always was collected associated with submerged vegetation. Apparently, the fish were not resting on the streambed, because the plants were closely packed, leaving on part of the bed exposed. One fish was seen resting on and seeking shelter in the aquatic plants. All specimens were collected by dip-netting. Usually two or three specimens were collected in the same or subsequent attempts at the same spot, which strongly suggests that the species is gregarious. *Aspidoras velites* was collected sympatrically with another, unidentified *Aspidoras*, which was also collected in the banks of submerged aquatic macrophytes. Unlike the new species, however, the unidentified *Aspidoras*

apparently preferred exposed sandy or muddy bottoms, and inhabited several small shallow streams lacking aquatic macrophytes.

Distribution.—Known only from small tributaries of the upper Rio Araguaia (rio Tocantins drainage): ribeirão do Sapo, córrego Gordura, and its affluent, córrego Boiadeiro, Estado do Mato Grosso, Brazil (Fig. 5).

Etymology.—From the Latin *velites,* plural of *veles,* light-armed troops of the Roman army which usually opened the fighting hurling javelins, retreating among the ranks of the heavy infantry as the struggle advanced. In allusion to the relatively delicate complexion of the fish. A noun in apposition.

Discussion

Among *Aspidoras* species there is a relatively small degree of morphological and color variation, with most species having a relatively bulky body and marbled color pattern. Exceptions are *Aspidoras virgulatus,* which has three dark longitudinal stripes (Nijssen & Isbrücker 1980: fig. 1), and *A. pauciradiatus,* which has some paedomorphic features (Weitzman & Balph 1979). *Aspidoras velites* is also a very distinct, aberrant species, with an elongate body, several reductive features, and a remarkable color pattern similar to that of *A. virgulatus.* However, placement of the new species in *Aspidoras* is not questioned because it shares the exclusive characters of the genus, i.e., small supraoccipital and frontal fontanels, and short supraoccipital posterior process (Nijssen & Isbrücker 1976, Reis 1998).

Among the reductive features of *Aspidoras velites,* one of the most obvious is the naked predorsal area (Fig. 3). In other members of the Callichthyidae, the dorsolateral body plates meet each other at the dorsal midline between the supraoccipital and nuchal plate (e.g., Lima & Britto 2001: fig. 2). In juvenile callichthyids, the entire mid-dorsal area is naked, with the lateral body plates apparently originating in the midlateral body region, subsequently developing towards the dorsal and ventral areas.

The reduced and narrow posterior process of supraoccipital is also a unique, reductive character of the new species. Among corydoradine catfishes, the supraoccipital process is typically wide, and its length varies from touching the nuchal plate, as in *Corydoras* and *Brochis,* to separated from the nuchal plate by two to four dorsolateral body plates, as in *Aspidoras.* However, in *Aspidoras,* the length of the supraoccipital process is never less than three-fourths of its distance from the nuchal plate. In *Aspidoras velites,* the length of the supraoccipital posterior process is less than half its distance from the nuchal plate.

In *Aspidoras velites,* the first pectoral- and dorsal-fin rays are weakly ossified. The first pectoral- and dorsal-fin rays in Corydoradinae, as in other catfishes, have co-ossified segments forming strong spines (Reed 1924). In *Aspidoras,* the segments of the first pectoral-fin ray are co-ossified only in its proximal half, remaining separated distally. In *Aspidoras velites,* the segments of the first pectoral-fin ray do not co-ossify into a pectoral spine. Although the segments of the first dorsal-fin ray are co-ossified, this spine is not strong as in other corydoradine catfishes, remaining weak and slender.

Other reductive characters present in *Aspidoras velites* are the poorly ossified hypobranchial 2, and the reduced infraorbital flanges. Poorly ossified hypobranchials also are observed, among loricarioids, in trichomycterids, nematogenyids, and callichthyines (de Pinna 1992: fig. 6). Among corydoradines, a poorly ossified second hypobranchial is observed in two small-sized species, *Corydoras hastatus* and *C. pygmeus.* The infraorbital bones in corydoradine catfishes typically have well-developed flanges (Reis 1998: fig. 12), except for *C. hastatus* and *C. pygmeus,* which have reduced flang-

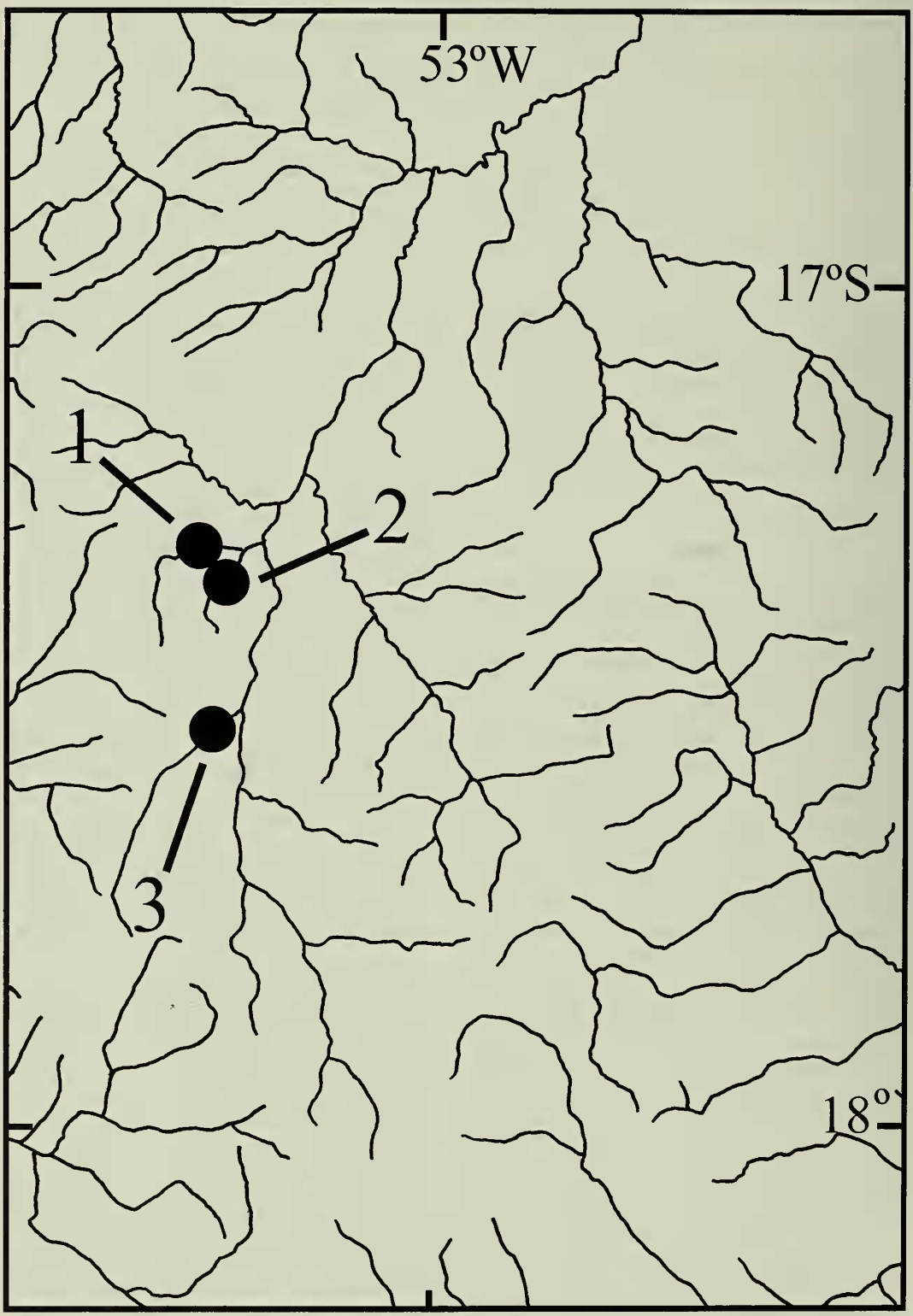

Fig. 5. Map of upper Rio Araguaia basin and adjoining river basins, showing the distribution of *Aspidoras velites* (dots). 1—córrego Boiadeiro (type locality); 2—córrego Gordura; 3—ribeirão do Sapo.

es. Since these two characters are present in small-sized species, as well as juvenile specimens, we suggest that they represent paedomorphic features.

Additionally, *Aspidoras velites* has several minute vermiculate platelets with few odontodes on the ventral surface of the body between the isthmus and the pelvic region (Fig. 4). Some members of *Corydoras* also have numerous platelets in this region (Fraser-Brunner 1947: fig. 3). However, in these *Corydoras* the platelets are roughly quadrangular and closely packed, with no naked areas between them.

As noted above, *Aspidoras velites* presents several features that can be considered paedomorphic. Weitzman & Vari (1988) listed seven species of corydoradine catfishes as miniature (i.e., not exceeding 26 mm SL). Schaefer et al. (1989:205–206) associated the reduction in adult body size in three of these miniature corydoradines, *Aspidoras pauciradiatus, Corydoras pygmaeus,* and *C. hastatus,* with a decreased number of pectoral- and dorsal-fin rays, and lateral body plates. *Aspidoras velites* reaches a maximum standard length (27.9 mm) greater than the limit (26 mm SL) established by Weitzman & Vari (1988) for miniature fishes. The new species also does not share with *Aspidoras pauciradiatus, Corydoras pygmaeus,* and *C. hastatus,* the reduction in the number of pectoral- and dorsal-fin rays, and lateral body plates. However, *Aspidoras velites* possesses, as discussed above, several other features indicating that the new species is likely to be a paedomorphic catfish.

Aspidoras velites bears a remarkable overall resemblance to hypoptopomatine catfishes, particularly species of *Otocinclus.* Sands (1985:36–37) noticed a close resemblance in color pattern between two *Corydoras/Otocinclus* species-pairs in southeastern Brazil, namely *Corydoras paleatus* and *Otocinclus flexilis,* and *Corydoras nattereri* and an unidentified *Otocinclus* species (actually *O. affinis,* pers. obs.). Sands (1985) suggested that these *Otocinclus* species might gain some advantage in this mimicry, because species of *Corydoras* have strong pectoral- and dorsal-fin spines, presumably used as anti-predatory devices. *Aspidoras velites* was not collected sympatrically with any hypoptomatine catfishes. Interestingly, however, it occurred in the same microhabitat (submerged vegetation) often occupied by hypoptopomatines.

Comparative material examined.—A complete list of comparative material was given by Lima & Britto (2001). Additional material includes: *Corydoras hastatus* MZUSP 35908, 4 ex., 2 cs; UFRJ 0384, 31 ex., 5 cs; UFRJ 1909, 2 ex.; UFRJ 3654, 6 ex., 1 cs; UFRJ 3655, 5 ex.; UFRJ 3656, 2 ex.; UFRJ 3657, 4 ex.; UFRJ 3658, 3 ex.; UFRJ 3659, 3 ex.; UFRJ 3660, 3 ex.; UFRJ 3831, 5 ex., 2 cs; *C. pygmaeus* MZUSP 26344, 4 ex.; USNM 218355, 5 ex., 2 cs.

Acknowledgments

We are thankful to Janet W. Reid, Mark Sabaj, Mônica Toledo-Piza, and Stanley Weitzman for reading and commenting on the manuscript. Augusto Aquila prepared figures 1 and 3. We thank Ferronorte S.A. and Tetraplan Consultoria e Planejamento, which made fieldwork possible. David and Valdeci assisted in the fieldwork. The authors received financial support from FAPESP (Fundação de Amparo a Pesquisa do Estado de São Paulo).

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